

Technical Reference and Operating Manual

MiniTest FH 2100 / FH 4100

Please unfold the inside page. You will then find an overview of the MiniTest FH 2100 / FH 4100 display as well as brief operating instructions for the basic functions.

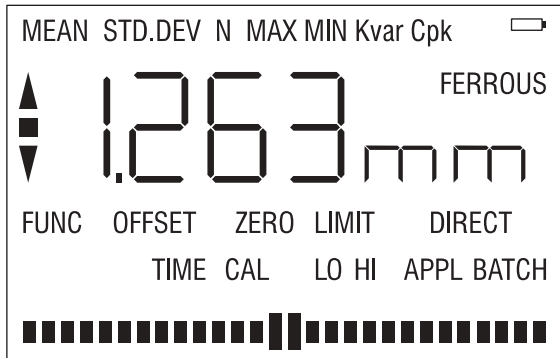
This information will help you to quickly find your way through the operating manual.

© 10/2000 774/98-A2 for the software release 1.08

The software version is indicated in the display test (ref. chapter 5.1 *Basic settings*).

Subject to change without notice.

Display



The displays below the reading appear depending on the setting currently in process.

MEAN	Mean value
STD.DEV	Standard deviation
N	Number of readings
MAX	Maximum reading
MIN	Minimum reading
Kvar	Variation coefficient
Cpk	Process capability index
	Battery charge indicator
	Position of reading
Large-size no.	Display of reading
FERROUS	Type of material (only active for coating thickness measurement)
mm	Units of reading
FUNC	Secondary function of key
OFFSET	Constant quantity
ZERO	Zero calibration
LIMIT	Limit default
DIRECT	Direct measurement mode
TIME	Time and date setting
CAL	Calibration
LO	Lower limit value
HI	Upper limit value
APPL BATCH	Batch measurement mode
	Analog thickness display

Operation of basic functions

Factory standard calibration (only for 5mm ball or measuring range of 0...8 mm)

Press ZERO key and then the key CLEAR/CLR STATS.

Zero calibration

Press ZERO key, then place centering sleeve with steel ball on the probe and press ZERO again.

Two-point calibration

Carry out zero calibration first.

After that, press CAL key, place calibration standard horizontally against the probe tip and position steel ball. Use the arrow keys to adjust the displayed reading to the value of the calibration standard and conclude by pressing the CAL key.

Measuring the wall thickness

Position the steel ball in the hollow body to be measured or on the surface of the test object and "recover" it by means of the probe tip. Store the displayed reading by means of the $\hat{\uparrow}$ key.

Erasing the complete memory

Switch the instrument off, then press the three keys CLEAR/CLR STATS, FUNC and ON/OFF one by one and keep them pressed for approx. 3 seconds.

Contents

1 Introduction	1-1	1.5 Layout and presentation in this manual	1-9
1.1 Safety information	1-2	Listings	1-9
Batteries	1-3	Operating steps	1-10
Software	1-3	Note and attention symbols	1-10
Errors and exceptional stresses	1-3	2 Scope of supply and accessories ...	2-1
1.2 Important information on thickness measurement	1-4	2.1 Scope of supply	2-3
Preconditions for magnetic thickness measurements	1-4	2.2 Required accessories	2-4
Operator training	1-4	2.3 Recommended accessories	2-5
Limitations of magnetic thickness measurement	1-5	3 Start-up	3-1
1.3 MINITEST FH 2100 / FH 4100	1-6	3.1 Power supply	3-2
1.4 How to use this operating manual	1-9	Inserting batteries	3-2
For a quick grasp of the operating manual	1-9	Operation using the power supply unit	3-3
		3.2 Connecting the probe	3-4

Contents

4 Fundamental principles of operation	4-1
4.1 Screen displays	4-2
Resolution of the digital display	4-3
4.2 Keys	4-4
4.3 Turning the instrument on and off	4-6
Turning on	4-6
Turning off	4-6
4.4 How to use the probe	4-7

Operation 5	5-1
5.1 Basic settings	5-2
Setting the time and date	5-2
Carrying out LCD test	5-3
Defining other basic settings	5-3
Units	5-4
Off mode	5-5
Transfer data format	5-5

Statistics	5-6
Data transfer to the data logger	5-6
Waiting for a stable reading	5-7
Key lock.....	5-7
Display backlight	5-8
Storage of minimum reading	5-8
Alarm horn	5-9
5.2 Calibrating the instrument	5-10
General information of calibration	5-10
Calibration methods	5-12
Zero calibration	5-13
Two-point calibration	5-14
OFFSET setting (FH 4100 only)	5-15
LIMIT setting (FH 4100 only)	5-16
5.3 Selecting the operating mode	5-17
DIRECT mode	5-17
APPL-BATCH mode (FH 4100 only)	5-17
Selecting an APPL-BATCH memory location	5-18

5.4 Measuring the wall thickness	5-19		
5.5 Evaluating the resulting measurement data	5-20		
Single-value statistics	5-21		
Block statistics	5-22		
Printout of memory allocation (FH 4100 only)	5-23		
5.6 Delete functions	5-24		
Deleting the last reading	5-24		
Deleting statistical values on the FH 2100 and in the DIRECT mode on the FH 4100	5-24		
Deleting a measurement series including statistical values (FH 4100 only)	5-24		
Deleting a measurement series including statistical and limit values (FH 4100 only)	5-25		
Deleting limit values (FH 4100 only)	5-25		
Deleting all measurement series in an application memory (FH 4100 only)	5-26		
		Deleting all measurement series in all application memory locations (FH 4100 only)	5-26
		5.7 Coating thickness measurement	5-27
		Calibration	5-27
		Probe F20	5-32
		Probe F50	5-32
		Tube probes F1.6/90 und N1.6/90	5-32
		Probe CN02	5-33
		Universal probe FN1.6	5-33
		Probes N10 and N20	5-33
		Probe N100	5-34
		6 Documenting measurement results	6-1
		6.1 Printer	6-2
		6.2 Printer start-up	6-4
		Charging batteries	6-4
		Connecting the printer	6-4
		Changing the roll of paper	6-5

Contents

Changing the ink ribbon cartridge	6-5	10 Annex	10-1
Carrying out printer self-test	6-6	10.1 Definitions for statistics	10-2
Printout of APPL-BATCH directory (FH 4100 only)	6-7	Mean value (Mean)	10-2
Printout of single-value statistics with histogram (FH 4100 only)	6-8	Standard deviation s (St. D)	10-2
Application software MSOFT41	6-9	Variation coefficient (Kvar)	10-2
7 Maintenance and care	7-1	Process capability index (Cp) (only FH 4100)	10-2
7.1 Care	7-2	Process capability index (Cpk) (only FH 4100)	10-3
Instrument care	7-2	10.2 Error messages	10-3
How to use NiMH batteries	7-2	10.3 EC declaration of conformity	10-5
7.2 Maintenance	7-3	10.4 Service addresses	10-6
8 Technical data	8-1	11 Changes	11-1
9 Interface	9-1	12 Index	12-1
9.1 Description of interfaces	9-2		
Data format	9-2		
Interface allocation	9-2		

Introduction 1

1.1 Safety information

The gauges MiniTest FH 2100 and FH 4100 are designed and tested according to DIN EN 61 010 Part 1, March 1994, Safety requirements for electric measurement, control and laboratory equipment, and were in technically perfectly safe condition when leaving our works.

To maintain this condition and to ensure a safe operation, it is absolutely necessary that you read the following safety information before putting the gauge into operation.

Moreover, FH 2100 and FH 4100 correspond to the standard specifications DIN EN ISO 2178, 2360, as well as DIN 50982, ASTM B499, B244 and BS 5411.

A Attention:

The gauges MiniTest FH 2100 and FH 4100 are meant for materials testing. Medical or any other applications are not permitted!

A Attention:

Static magnetic fields, amounting to a max. 1 mT, occur at a distance of 15 cm from the probe. Users carrying pacemakers should always consult their doctor to find out whether and to what extent these magnetic fields could affect the pacemaker function.

A Attention:

The direct-current magnetic field generated by the probe can influence or destroy electronic devices or gauges. Please stay at a safety clearance of 15 cm away, especially from any computers, display screens and magnetic recording media (floppy disks, cards with magnetic stripes).

H Note:

Always use the screening tube for protection and transportation of the probe FH8 (contained in the delivery package, for screening the magnetic field).

Batteries

The gauges MiniTest FH 2100 / FH 4100 can be operated with rechargeable batteries or other battery types, or a power supply unit. Please only use the products recommended by us for the battery operation.

When the power supply plug is inserted into the instrument's power connector, the batteries are automatically disconnected and the instrument operates from AC power.

Please read chapter 7 *Maintenance and care* for more details on how to handle batteries.

Software

According to the current state of the art, software is never completely free of errors.

Before using any software-controlled test instruments it is therefore necessary to ensure that the required functions operate perfectly in the intended combination.

If you have any questions concerning the use of your Elektro-Physik test device, please contact your nearest Elektro-Physik representative.

Errors and exceptional stresses

If you have reason to believe that a safe operation of your MiniTest FH 2100 / FH 4100 is no longer possible, the gauge must be disconnected and secured against unintentional reconnection.

A safe operation is no longer possible, e.g.

- if the gauge shows visible damages
- if the gauge no longer operates perfectly
- after prolonged storage under adverse conditions
- after being subjected to heavy stresses during transportation

1.2 Important information on thickness measurement

Please read the following information before using your MiniTest FH 2100 / FH 4100. It is important that you understand and observe this information to avoid any operator errors that might lead to false test results.

Preconditions for magnetic thickness measurements

This operating manual contains essential information on how to operate your thickness gauge. In addition, there are a number of factors which affect the measurement results. A description of these factors would go beyond the scope of an operating manual. The following list therefore only mentions the three most important conditions for a safe and reliable magnetic thickness measurement.

- the operator (inspector) training
- the knowledge of special technical requirements and limitations of measurements
- the choice of appropriate measuring equipment

Operator training

The operation of a magnetic measuring device requires a proper training in thickness measurement methods. A proper training comprises adequate knowledge of the following topics:

- fundamental principles of magnetic field measurement (Hall effect)
- effects of environmental conditions on magnetic fields
- effects of surface quality of the test material on the measurement
- statistic evaluation methods of series of measured values

Lack of knowledge of the above-mentioned topics can lead to false measurement results with unforeseeable consequences. Information on the facilities existing for training of materials testing personnel as well as on the qualifications and certificates possible can be obtained from national NDT societies and organizations, e.g. in Germany from **Deutsche Gesellschaft für Zerstörungsfreie Prüfung e.V.**, Motardstraße 54, D-13629 Berlin; or also from Elektro-Physik, Technical Training department.

Elektro-Physik organizes training courses for technical personnel specialized in nondestructive materials testing at regular time intervals. The scheduled dates will be given to you on request.

Limitations of magnetic thickness measurement

Magnetic thickness measurements can only provide information about those parts of the test object which the magnetic field of the probe used has actually covered. Assumptions about those parts of the test object which have not actually been tested, based on those parts which have been tested, should only be made with extreme caution. Such assumptions are usually only allowed where a large amount of previous data is available and proven methods of statistical data acquisition and evaluation are used.

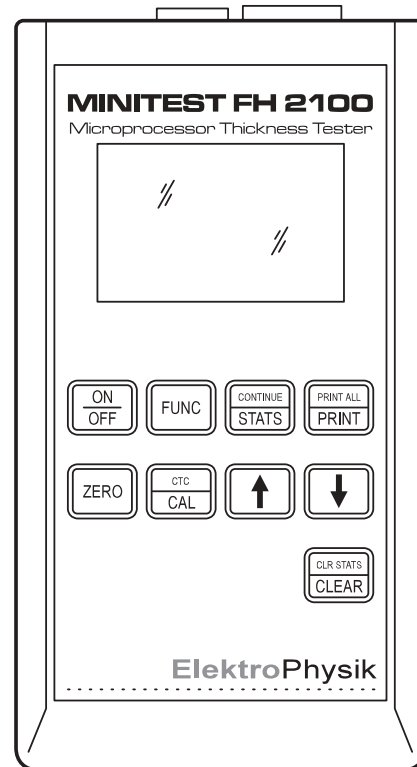
H **Note:**

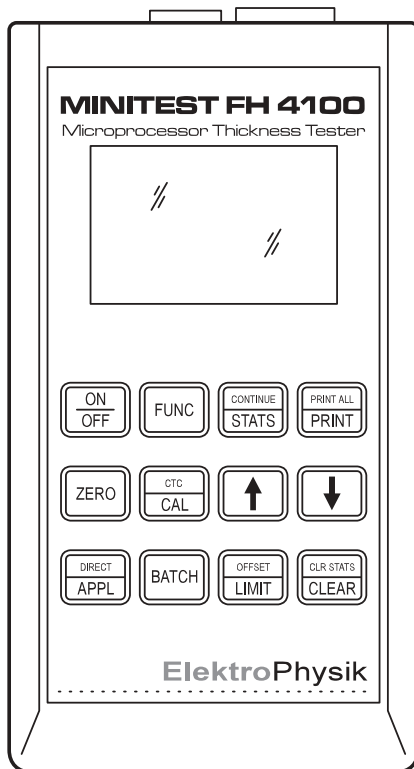
The information given on the preconditions and limitations as well as on the training of the inspector apply likewise to the coating thickness measurement.

1.3 MiniTest FH 2100 / FH 4100

The MiniTest FH 2100 / FH 4100 is a lightweight and compact thickness gauge, especially developed for the nondestructive measurement of wall thicknesses of all nonmagnetic materials. Used in combination with special probes, it can also be used for carrying out coating thickness measurements, e.g. on coats of varnish and galvanized coats on steel and nonferrous metals.

A small steel ball is used for thickness measurements. This ball is attracted through the wall to be measured by the magnetic tip of the probe placed on the opposite side of the wall. The wall thickness between the ball and the probe tip is immediately digitally displayed.





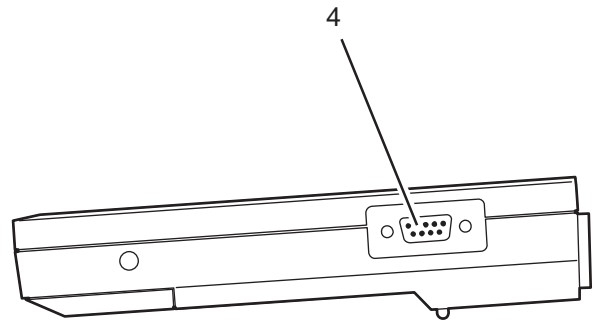
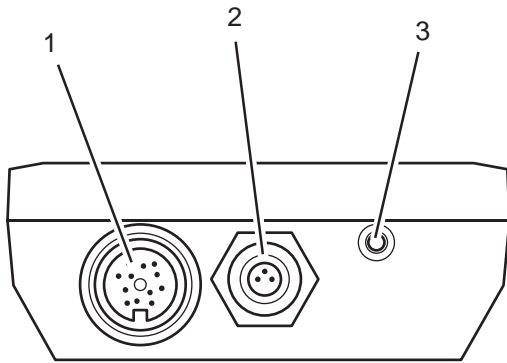
Special features of MiniTest FH 2100 / FH 4100

- Low weight (270 g) and small dimensions
- Easy-to-clean operator panel
- Easy-to-survey measured-value monitoring on the large-size LC display
- Thickness measurements on very close radii of up to 0.75 mm are possible
- High scan rate of 7 measurements per second
- FH 4100 with measured-value memory for max. 500 groups of measurement series and 10,000 readings in total (FH 2100 with measured-value memory for 1 group of measurement series and 10,000 readings)
- Single and continuous measurements with extensive statistics functions
- Display and recording of the minimum value
- Possibility of documentation via a printer

Inputs and outputs

Next to the socket for the probe (1), MiniTest FH 2100 / FH 4100 has a foot switch connection (2). You can use the socket no. (3) to connect the optional power supply unit for longer measurement series.

There is a serial connector socket (4) on the right side of the instrument for connecting the optional printer MiniPrint 4100 or to interface to a computer..



1.4 How to use this operating manual

For a quick grasp of the operating manual

Before operating the MiniTest FH 2100 / FH 4100 for the first time, it is absolutely necessary that you read the chapters 1, 3 and 4 of this manual. They will inform you about the necessary preparations of the instrument, the use of different probe types and give you a description of all keys and screen displays.

In doing this, you will avoid any interferences or failures of the instrument and be able to use the full range of instrument functions.

You will find the latest changes to this operating manual in chapter 11 *Changes*. It describes corrections that have become necessary at short notice and have not yet been included in the general manual. If no corrections have become necessary, this chapter is empty.

1.5 Layout and presentation in this manual

To make it easier for you to use this manual, all operating steps, notes, etc., are always presented in the same way. This will help you find individual pieces of information quickly.

Listings

Listings are presented in the following form:

- Variant A
- Variant B
- ...

Operating steps

Operating steps appear as shown in the following example:

- Loosen the two screws at the bottom.
- Remove the cover.
- ...

Note and attention symbols

H Note:

Note contains e.g. references to other chapters or special recommendations for a function.

A Attention:

The **Attention** symbol indicates peculiarities and special aspects in the operation which could affect the accuracy of the results.

Scope of supply and accessories **2**

Scope of supply and accessories

This chapter informs you about the scope of supply and accessories available for the MiniTest FH 2100 / FH 4100.

It describes

- accessories included in the scope of supply,
- required accessories,
- recommended accessories and
- accessories for coating thickness measurements.

2.1 Scope of supply

Description	Order number
Thickness gauge MiniTest FH 4100 with data logger, for non-magnetic materials	80-119-0106
or	
Thickness gauge MiniTest FH 2100 for non-magnetic materials	80-118-0106
each including:	
operating manual, English	20-133-0005
alkaline battery, 9 V	02-064-0011
carrying case, plastic	82-020-0006
dust-cover, transparent	85-139-0036
screw-driver, Phillips	05-005-0077

2.2 Required accessories

Description	Order number
Probe FH 8 for thickness measurements, measuring range: 0 ... 8.0 mm	80-0B0-0001
including:	
1 screening tube for protection of the magnetic field	
1 package with 100 balls ea. 1.5 mm and 3 mm dia., 1 package with 25 balls 5 mm dia.	
1 centering sleeve each for balls with 1.5 mm, 3 mm, 5 mm dia.	
3 calibration standards 1 mm, 3 mm, 6 mm	
1 adaptor cap for plane-parallel application of calibration standards	
1 magnetized screw-driver for easy recovery of the ball	

2.3 Recommended accessories

Description	Order number
Portable data printer MiniPrint 4100	80-201-0103
including:	
power supply unit with Euro/US adaptor	
4 NiMH batteries	
ink ribbon cartridge, black	
3 rolls of printer paper	
power supply unit with Euro/US adaptor for FH 2100 / FH 4100 and MiniPrint 4100	02-070-0020
1 NiMH battery	02-064-0001
ink ribbon cartridge, black	85-159-0028
1 roll of printer paper	06-007-0011
rubber case with prop-up stand for MiniTest FH 2100 / FH 4100	82-010-0014

Description	Order number
Neck strap for rubber case	82-010-016
Dual bag for MiniTest FH 2100 / FH 4100, MiniPrint 4100	82-010-0009
Field belt with removable pouches for MiniTest FH 2100 / FH 4100, MiniPrint 4100 and accessories	82-010-0015
1 probe guide for probe FH 8, spring-mounted, with prismatic support	80-900-0500
3 calibration standards 1 mm, 3 mm, 6 mm	82-051-0001
Calibration device	70-0B0-0017
Centering sleeve for balls with 1.5 mm dia.	70-0B0-0014
Centering sleeve for balls with 3 mm dia.	70-0B0-0013
Centering sleeve for balls with 5 mm dia.	70-0B0-0012
Steel balls, package with 100 balls, 1.5 mm diameter each	08-014-0004
Steel balls, package with 100 balls, 3 mm diameter each	08-014-0005
Steel balls, package with 100 balls, 5 mm diameter each	08-014-0006
Data transfer cable for PC with serial interface, 9-way /25-way socket	85-159-0004

Description	Order number
Data transfer cable for Mitutoyo printer	85-139-0034
Data transfer cable Centronics for printer with parallel interface	02-020-0022
Software MSAVE (DOS) for transferring data to a PC, German/English	80-901-1501
Software MSOFT41 (Windows) for data transfer and management, German version	80-901-0102
Software MSOFT41 (Windows) for data transfer and management, English version	80-901-0302
Foot switch for transferring data to the MiniTest data logger	80-901-0700
Probe F 05 (measuring range: 0 ... 500 μm)	80-0A0-0201
Probe F 3 (measuring range: 0 ... 3000 μm)	80-0A1-0403
Probe F 1.6/90 (measuring range: 0 ... 1600 μm)	80-0A4-0200
Probe F 10 (measuring range: 0 ... 10 mm)	80-0A6-0001
Probe F 20 (measuring range: 0 ... 20 mm)	80-0A8-0001
Probe F 50 (measuring range: 0 ... 50 mm)	80-0AA-0000

Description	Order number
Probe FN 1.6 (measuring range: 0 ... 1600 μm)	80-080-0402
Probe N 02 (measuring range: 0 ... 200 μm)	80-0A2-0001
Probe N 1.6 (measuring range: 0 ... 1600 μm)	80-0A3-0302
Probe N 1.6/90 (measuring range: 0 ... 1600 μm)	80-0A5-0200
Probe N 10 (measuring range: 0 ... 10 mm)	80-0A7-0000
Probe N 20 (measuring range: 0 ... 20 mm)	80-0A9-0000
Probe N 100 (measuring range: 0 ... 100 mm)	80-0B1-0000
Probe CN 02 (measuring range: 10 ... 200 μm)	80-0B4-0001
Probe guide for precision measurements	80-900-0200

Start-up 3

3.1 Power supply

The thickness gauges MiniTest FH 2100 / FH 4100 are delivered equipped with a non-rechargeable alkaline monoblock battery (AlMn, 9 V, type 6 AM 6).

H Note:

Please remove the battery from the gauge if you are not going to use it for a longer period.

Exchange the battery at once if the battery symbol at the top right corner of the LC display is flashing in order to maintain the defined basic settings.

Take spare batteries with you if you aim to carry out measurements on site.

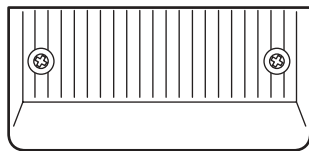
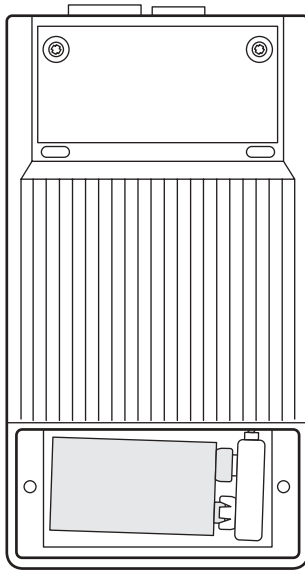
Faulty measurements due to too low supply voltage are excluded.

Inserting batteries

- Loosen the two bottom screws at the instrument rear and remove the cover.
- Plug the contact shoe in the terminals of the 9V block so that they lock into place firmly. A pole reversal is excluded.
- Insert the 9V block into the battery compartment. Pay attention to a proper feeder arrangement.
- Retighten the screws of the battery compartment cover.

H Note:

The new battery must be inserted within 10 seconds after removing the old battery, otherwise measured values and calibration values as well as basic settings are lost.



Operation using the power supply unit

Use the optional power supply unit if you want to carry out longer measurement series. The moment you connect the power supply unit to the thickness gauge MiniTest FH 2100 / FH 4100, the power supply from the battery compartment is interrupted.

H **Note:**

If you are using a rechargeable battery, you have to use an external charger for charging the battery.

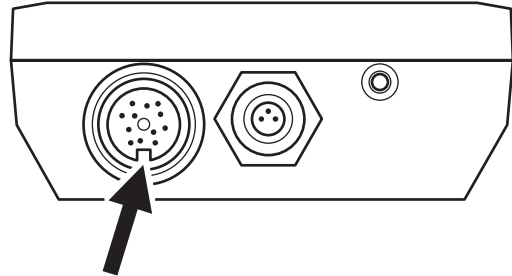
3.2 Connecting the probe

To prepare the MiniTest FH 2100 / FH 4100 for operation, you have to connect a probe of the type FH (FH 8, measuring range 0 ... 8 mm).

- Connect the probe cable with the connector socket at the head end of the instrument. Make sure that you put the “nose” of the male cable connector to the guiding groove of the socket.
- Insert the connector all the way up to the limit stop and fasten it with screws.

H **Note:**



Information on probes that can be connected for coating thickness measurements is given in chapter 5.7 *Coating thickness measurement*, table on page 5.31.



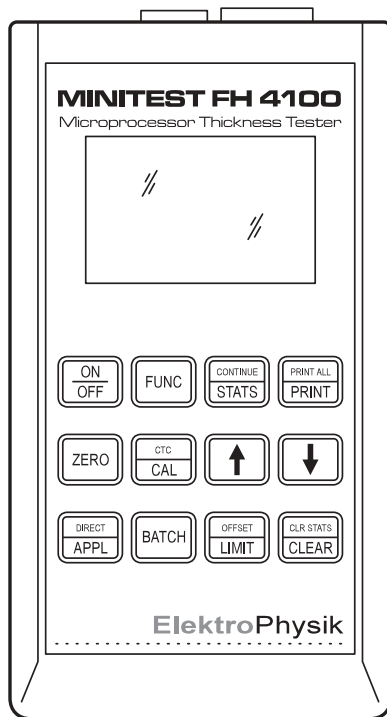
Fundamental principles of operation 4

4.1 Screen displays



Abbreviation	Description
MEAN	mean value
STD.DEV	standard deviation
N	number of readings
MAX	maximum reading
MIN	minimum reading
Kvar	variation coefficient
Cp	process capability index
Cpk	process capability index referred to the position of mean value
	indicator for discharged battery (flashing)
	position of reading referred to the predefined limit values
large digits	display of reading

4.2 Keys



The following table gives an overview of the functions of the MiniTest FH 2100 / FH 4100 keys.

Please also observe the description of the individual operating steps in chapter 5 *Operation*.

Key	Description
ON/OFF	turns instrument on or off
FUNC	activates secondary function of key (upper key labelling)
STATS/ CONTINUE	changes between continuous and single measurement
PRINT/ PRINT ALL	prints out the readings, statistical values and histogram
ZERO	carries out zero calibration
CAL/CTC	calibration using calibration standards
↑	increases an adjustment value, or transfers a value to the data memory
↓	reduces an adjustment value

Key	Description
APPL/ DIRECT	changes between APPL-BATCH and DIRECT modes (only FH 4100)
BATCH	selects a memory group (only FH 4100)
LIMIT/ OFFSET	sets limit values or a constant value for adding a reading or sub- tracting from it (only FH 4100)
CLEAR/ CLR STATS	deletes current data entry or statistics

4.3 Turning the instrument on and off

Turning on

- Press ON/OFF to turn the instrument on.

A short intermittent tone will sound and you will see the set units. The other screen displays depend on the mode that you were in before turning the instrument off the last time – either in DIRECT or in APPL-BATCH mode.

Turning off

- Press ON/OFF to turn the instrument off.

If you make no data entries and change no probes, the instrument is automatically switched off after approx. 1.5 minutes. (This setting can be changed, please refer to chapter *Basic settings*). This helps reduce power consumption so that you will not waste any battery operating time.

All basic settings and stored readings are kept after the instrument has been turned off.

4.4 How to use the probe

The MiniTest FH 2100 / FH 4100 automatically recognizes the connected probe. For the standard application – thickness measurement of nonmagnetic materials using a steel ball – the display reads FERROUS after the instrument has been turned on.

To be able to measure without any interferences, you should observe some rules concerning the handling of the probe:

- Connect the probe to the gauge before turning it on. Otherwise the error message E 2 is displayed and the instrument is automatically switched off.
- Carry out a thorough zero calibration and, in addition, a thorough calibration using the calibration standard included in the supply. This is the only way to ensure that your measurement results stay within the permissible tolerance limits.

- Select the location for the measurement so that no strong magnetic fields can have any effect on the test point. For instance, power transformers or conductor bars with high current intensities can largely corrupt the measurement data.
- Keep the probe as vertical as possible against the wall area to be measured and wait for the display to level out at a stable value.
- Use the probe guide which is available as an option for fixing the probe so that your hands are free and you can handle the object to be measured better.

A Attention:

Static magnetic fields, amounting to a maximum of 1 mT, occur at a distance of 15 cm from the probe. Users carrying pacemakers should always consult their doctor to find out whether and to what extent these magnetic fields could affect the pacemaker function.

A Attention:

The direct-current magnetic field generated by the probe can influence or destroy electronic devices or gauges. Please stay at a safety clearance of 15 cm away, especially from any computers, display screens and magnetic recording media (floppy disks, cards with magnetic stripes).

H Note:

Always use the screening tube for protection and transportation of the probe FH8 (contained in the delivery package, for screening the magnetic field).

Operation 5

5.1 Basic settings

Before using the instrument, you can define various basic settings, e.g.

- set time and date for the statistic evaluations of measurement series,
- select the required units of measurement (mm or inch),
- define statistic presets,

plus a number of other default data described below.

Function	Keys to press
Setting time and date	CAL + ON/OFF
LCD test	↑-key + ON/OFF
Basic settings	FUNC + ON/OFF
APPL-BATCH directory	APPL + ON/OFF
Total reset	FUNC + CLEAR + ON/OFF

Setting the time and date

The instrument provides quartz-controlled time data. In combination with the data printer, the current time and date are printed out for every statistics printout. However, time and date can also be viewed and updated on the display if required.

The MiniTest FH 2100 / FH 4100 is turned off.

- Press CAL and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see the two-digit number of the year (y), e.g. 98.
- Set the current year using the arrow keys.
The ↑ key increases the displayed value, the ↓ key reduces it.
- After setting the correct year, press CAL.
The value is now stored and you will move to setting of the month (M).
- Set the current month using the arrow keys.
- Press CAL.
You will move to setting of the day (d).

- Set the current day using the arrow keys.
- Press CAL.
You will move to setting of the hour (h).
- Set the current hour using the arrow keys.
- Press CAL.
You will move to setting of the minute (m).
- Set the current minute using the arrow keys.
- Press CAL.

You have now set and stored the time and date.

Carrying out LCD test

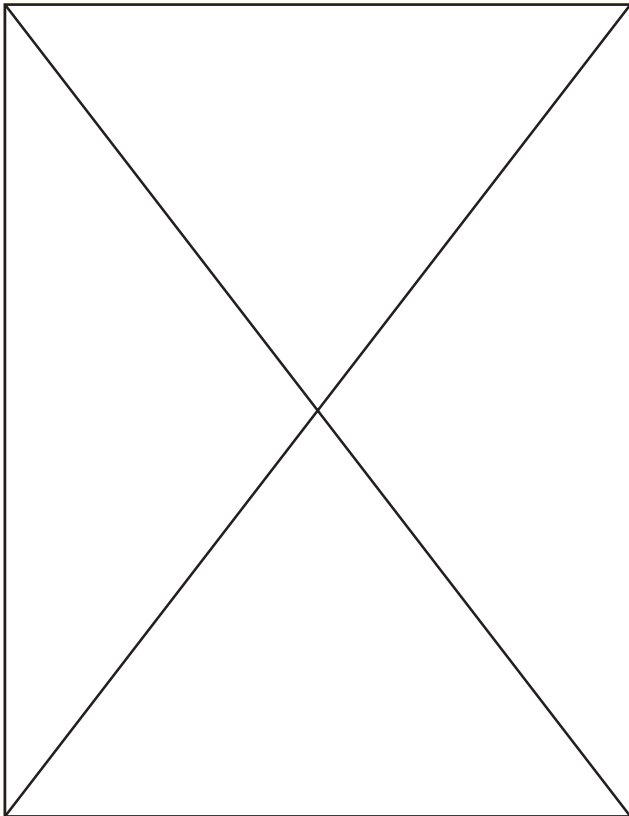
You can check that all displays are correctly shown in the LCD window.

- To achieve this, press \hat{u} and keep it pressed while you press ON/OFF.
All display fields are visible in the LCD window.
- If you let go of the \hat{u} key, the current software version, e.g. 1.08, is displayed for approx. 2 seconds.

Defining other basic settings

You can define another eight basic settings that you select via the FUNC key. For each basic setting, you can choose between 0 and 1 according to the table opposite. On delivery and after a reset, all eight settings are at 0.

The individual basic settings are described on the following pages.



Units

The instrument is turned off.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the units setting on the display.
- Use the arrow keys to choose between the value 0 for the units in mm and the value 1 for the units in inch.
- Press the FUNC key to save the setting and go to the next basic setting.

Off mode

This function allows the operator to activate or deactivate the automatic shut-off feature. When activated battery life is preserved by automatically turning the instrument off when inactive for periods greater than 1.5 minutes.

The instrument is turned off.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting of the turn-off mode on the display'.
- Press the FUNC key once so that 2.0 or 2.1 will be displayed.
- Use the arrow keys to choose between the value 0 for the short-time duty and the value 1 for the continuous running duty.
- Press the FUNC key to save the setting and to go to the next basic setting.

Transfer data format

The data format is dependant on the probe type. For thickness measurement, the data format is fixed at 3 decimal points with probe FH8.

The following applies to coating measurements:

You can change the data format of the readings transferred via the interface from the standard setting floating point to the data format fixed point.

In the fixed point format, all readings are transferred in "metric" units, in μm with one decimal point, or in the "Imperial" units, in mils with two decimal points.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting of the data format on the display.
- Press the FUNC key twice so that 3.0 or 3.1 is displayed.
- Use the arrow keys to choose between the value 0 for the data format with floating point and the value 1 for the data format with fixed point.

- Press the FUNC key to save the setting and to go to the next basic setting.

Statistics

The statistics can be calculated both as single-value statistics and as block statistics and transferred to the printer MiniPrint 4100 via the interface.

The block statistics are calculated from blocks of 5 readings each.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting of the type of statistics on the display.
- Press the FUNC key three times so that 4.0 or 4.1 is displayed.
- Use the arrow keys to choose between the value 0 for the single-value statistics and the value 1 for the block statistics.
- Press the FUNC key to save the setting and to go to the next basic setting.

Data transfer to the data logger

An automatic transfer of readings to the data logger is possible in continuous mode. If you only want to transfer certain readings, you can save the values by pressing the \hat{u} key once.

The transfer rate in the continuous mode is approx. 5 readings per second.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting of data transfer on the display.
- Press the FUNC key four times so that 5.0 or 5.1 is displayed.
- Use the arrow keys to choose between the value 0 for the single-value transfer at a key-press and the value 1 for the continuous measurement data transfer.
- Press the FUNC key to save the setting and to go to the next basic setting.

Waiting for a stable reading

The measured value is typically not displayed until the measuring signal has stabilized within a bandwidth (measured-value filter). However, this stabilization can be deactivated in the continuous measurement mode in order to be able to determine e.g. minimum and maximum thickness values more easily. T

Press the FUNC key and keep it pressed while you press ON/OFF.

An acoustic signal is given and you will see 1.0 or 1.1 for the current setting on the display.

- Press the FUNC key five times so that 6.0 or 6.1 is displayed.
- Use the arrow keys to choose between the value 0 for the stable reading and the value 1 for any reading.
- Press the FUNC key to save the setting and to go to the next basic setting.

Key lock

You can “lock” certain keys to prevent any accidental deletion of the calibration or the entry of an OFFSET value. The function applies to the keys ZERO, CAL and OFFSET.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key six times so that 7.0 or 7.1 is displayed.
- Use the arrow keys to choose between the value 0 for key release and the value 1 for key lock.
- Press the FUNC key to save the setting and to go to the next basic setting.

Display backlight

The gauges MiniTest FH 2100 / FH 4100 have a switchable display backlight. If the backlight is activated, the light will be on for about 2 seconds after every measurement data acquisition process.

Press the FUNC key and keep it pressed while you press ON/OFF.

An acoustic signal is given and you will see 1.0 or 1.1 for the current setting on the display.

- Press the FUNC key seven times so that 8.0 or 8.1 is displayed.
- Use the arrow keys to choose between the value 0 for the deactivation of the display backlight and the value 1 for the activation of the display backlight.
- Press the FUNC key to save the setting and to go to the normal measurement mode.

Storage of minimum reading

This function is used for determining the lowest reading of a series of measurements obtained after scanning a part. The current reading is always displayed during the measurement. After the probe has been lifted off, the minimum reading (the smallest value within the measurement series) is displayed during 5 seconds. During this time, the minimum reading can be transferred to the statistics by pressing a key. After the 5 seconds, or after the data transfer to the statistics, the minimum reading is deleted. If measurements are continued during this time, the previous minimum is maintained. This means e.g. that the previously recorded minimum can be briefly reviewed.

- Press the FUNC key and keep it pressed while you press ON/OFF.
An acoustic signal is given and you will see 1.0 or 1.1 for the current setting on the display.
- Press the FUNC key eight times so that 9.0 or 9.1 is displayed.

-
- Use the arrow keys to choose between the value 0 for the deactivation and the value 1 to activate the storage of the minimum reading.
 - Press the FUNC key to save the setting and to go to the normal measurement mode.

Alarm horn

The alarm horn is used for an acoustic alarm in case the limit values are exceeded or not reached during the measurement in continuous mode.

- Press the FUNC key nine times so that 10.0 or 10.1 is displayed.
- Use the arrow keys to choose between the value 0 for the deactivation and the value 1 for the activation of the alarm horn.
- Press the FUNC key to save the setting and to go to the normal measurement mode.

5.2 Calibrating the instrument

Before you can measure wall thicknesses, you have to carry out a zero calibration in order to adjust the MiniTest FH 2100 / FH 4100 to the steel ball to be used (1.5 mm, 3 mm or 5 mm diameter).

Use the centering sleeves with the corresponding matching steel balls, included in the supply, for the zero calibration.

Use the calibration standards and the adaptor cap, likewise included in the supply, for the two-point calibration.

Measuring range	Target steel ball	Calibration standard
0 ... 2 mm	Ø 1,5 mm	approx. 1 mm
0 ... 4 mm	Ø 3 mm	approx. 3 mm
0 ... 8 mm	Ø 5 mm	approx. 6 mm

General information of calibration

Please observe the following:

- If the probe is held in the air, 4 dashes (- - - -) must always be displayed in the continuous measurement mode (standard mode). If a reading is displayed, press CLR STATS/CLEAR. The display will again show 4 dashes.
- Make sure that no strong magnetic fields affect the measuring point.
- Before calibrating, you have to clean the probe tip, the steel ball and the calibration standard. Any foreign bodies will corrupt the reading.
- When carrying out any calibrations and measurements, you have to leave the probe positioned until an acoustic signal is given; after that, you can lift off the probe.
- The closer the thickness value of the calibration standard is to the thickness of the object to be measured, the more accurate the calibration and consequently also the measurement will be.

- For all-round or circumferential measurements on bottles or other cylindrical hollow bodies, we recommend the use of the spring-mounted probe guide with prismatic support.

A Attention:

If the instrument switches off by itself due to exhausted batteries, you have to repeat the complete process.

H Note:

Each time the steel ball is lifted off from the probe tip in a distance of more than 30 mm / 1¼ inches, the gauge will be automatically calibrated to compensate possible drift errors which might be caused by variations in temperature, for instance.

Wall thickness measuring accuracy increases with increasing probe lift-off frequency (minimum 3 x per minute).

It is recommended to check calibration after 1 hour of non-stop operation. If necessary, a two-point calibration is to be carried out.

Calibration methods

The calibrations described below refer to thickness measurements by means of the probe FH 8. You have to make special preparations for calibrations for coating thickness measurements using other probes, depending on the probe used. For more details on this, please read section 5.7 *Coating thickness measurement* in this chapter.

Depending on the application case, you can calibrate the MiniTest FH 2100 / FH 4100 by two methods:

- Only zero calibration (single-point calibration) is a calibration mode that can be carried out quickly and provides adequate accuracy (please see table opposite).
- The two-point calibration is suitable for measurements requiring a higher accuracy (please see table opposite). Using the 1.5 mm steel ball always requires two-point calibration. The measuring accuracy as shown under „Only Zero Calibration“ in the table below only applies if both calibration methods, Zero calibration and 1 mm calibration have been performed before taking measurement.

Measuring range	Measuring accuracy	
	Only zero calibration	Two-point calibration
0 ... 2 mm	$\pm(5 \mu\text{m} + 3 \%^{*})$	$\pm(5 \mu\text{m} + 1 \%^{*})$
0 ... 4 mm	$\pm(10 \mu\text{m} + 3 \%^{*})$	$\pm(10 \mu\text{m} + 1 \%^{*})$
0 ... 8 mm	$\pm(20 \mu\text{m} + 3 \%^{*})$	$\pm(20 \mu\text{m} + 1 \%^{*})$

^{*)} measurement value

The measurement range is dependent on the selected steel ball (refer to table on page 5-10).

A Attention:

The following situations require the clearance of the statistics by pressing the CLR STATS/CLEAR before calibrating the gauge:

- If the steel ball has drifted laterally to the inclined flank. This might lead to a distortion of the magnetic field which might involve measuring errors if clearance has not been carried out previously.
- If the value of the calibration standard to be used will not be accepted for two-point calibration.

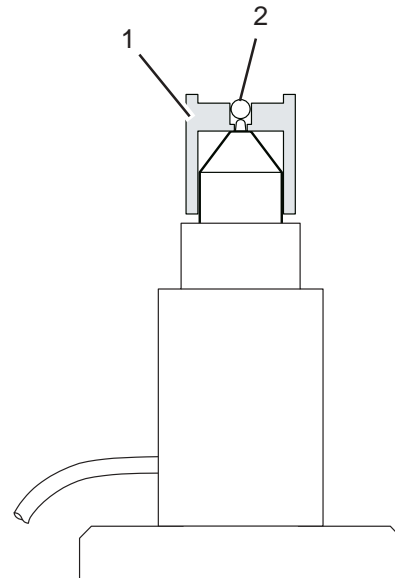
- If the steel ball has been lift off from the object to be measured and a reading is shown instead of a four-score indication (- - -).

Zero calibration

Depending on the required measuring range, choose the corresponding target ball as counterpole or calibration standard for the zero calibration according to the table on page 5-10.

- Connect the probe and turn the instrument on.
- Place the probe in a vertical position.
- Press ZERO.
The display shows a flashing ZERO.
- Place the centering sleeve (1) on the probe tip and insert the proper steel ball (2) into the hole of the sleeve.
You will hear a recurrent acoustic signal. After every acoustic signal, a zero value is automatically measured. To increase the accuracy, the instrument averages all measured zero values on pressing of the ZERO key.

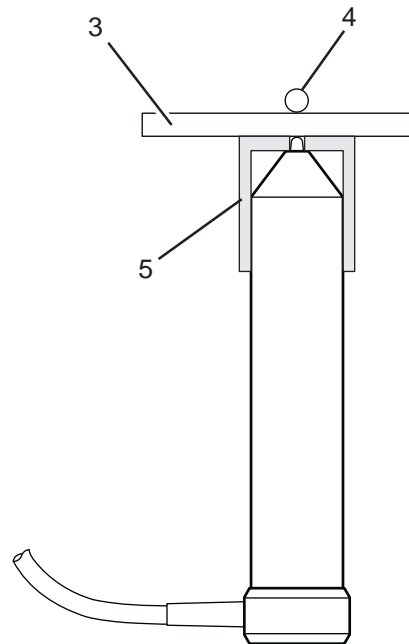
- Press the ZERO key again to close the zero calibration.
The display shows the reading 0.0 and a non-flashing ZERO annunciator.
- Repeat the procedure when no ZERO annunciator appears on the display.



Two-point calibration

In two-point calibration, you will carry out a zero calibration first and then a calibration using a corresponding calibration standard.

- Make a zero calibration as described in the previous section.
- Place the adaptor cap (for plane-parallel positioning of the calibration standard) (5) on the probe tip and press CAL. The display shows a flashing CAL.
- Place the calibration standard (3) on the adaptor cap and then place the steel ball (4) on the calibration standard. You will hear a recurrent acoustic signal. A calibration value is automatically measured after every acoustic signal. To increase the accuracy, the instrument averages all calibration values measured on pressing CAL.
- Vary the displayed reading using the arrow keys until it is adjusted to the value marked on the calibration standard.
- Press CAL again to close the calibration process. The display shows a non-flashing CAL.



A Attention:

Carry out the calibration thoroughly. An inclination of the calibration standard changes the measured value and results in an incorrect averaging of the calibration value.

If required, break off the calibration process using the key CLR STATS/CLEAR and repeat it again.

OFFSET setting (FH 4100 only)

You can use the OFFSET function to preset a constant positive or negative value to be added to the measured value. The function can be used both in DIRECT and in APPL-BATCH mode. In the APPL-BATCH mode, the OFFSET value is stored in an application memory (APPL).

H Note:

The offset value must be inputted prior to storing the readings.

- Press the FUNC key and then LIMIT/OFFSET.
The display shows a flashing OFFSET and the last OFFSET setting is displayed.
- Set the required OFFSET value via the arrow keys.
- Press LIMIT/OFFSET again to save the new value.
The set value is now always automatically added to or subtracted from the measured value.

LIMIT setting (FH 4100 only)

You can preset an upper and a lower limit value for evaluating your measurement series. These limit values can be preset before, during or after a measurement series and will help in the following way with the evaluation of a measurement series:

- Readings beyond the set limit values are signaled acoustically during the measurement and marked in the statistics printout.
 - < : reading is smaller than the lower limit value
 - > : reading is higher than the upper limit value
- An analog bar graph display is superimposed on the display screen below and a trend display appears to the left of the reading.
 - The arrowhead pointing upward (▲) indicates a reading above the upper limit value; at the same time, you will see the right section of the bar graph display on the display screen below.
 - The arrowhead pointing downward (▼) indicates a reading below the lower limit value; at the same time, you will see the left section of the bar graph display on the display screen below.
 - The black square (■) is displayed if the reading is

within the preset limit values; at the same time, the running bar graph display adjusts itself at its mid position.

- The histogram to be printed out is calculated from all values.

H **Note:**

Both limit values cannot be set below a minimum distance for technical reasons. If you try to set a smaller distance, the minimum distance is automatically selected.

- Press LIMIT/OFFSET.
 - A flashing LIMIT LO appears on the display and the lower limit value last set is displayed.
- Use the arrow keys to set the required lower limit value.
- Press LIMIT/OFFSET again.
 - The display shows a flashing LIMIT HI and the upper limit value last set is displayed.
- Use the arrow keys to set the required upper limit value and, finally, press LIMIT/OFFSET once again.

5.3 Selecting the operating mode

Unlike the FH 2100, the FH 4100 has two operating modes, the DIRECT mode and the APPL-BATCH mode. The FH 2100 only uses the DIRECT mode.

DIRECT mode

The DIRECT mode is well suited for the simple and quick measurement with measured-value indication on the display and a subsequent printout of the statistical evaluation if required. Up to 10,000 single measurements can be statistically evaluated in the DIRECT mode.

The FH 2100 sequentially stores individual values sent to the data logger by pressing the \hat{u} key. As additional readings are taken, the statistical values are recalculated and the memory updated. Individual values along with their statistics are stored for direct printouts by the MINIPRINT 4100 or transferred to a PC by using MSAVE or MSOFT utility software.

When operated in DIRECT mode, the FH 4100 stores only statistical data. Individual values are deleted from the data logger memory.

When you turn on the FH 4100, you will be in the mode that was last used for a measurement. If you want to switch from APPL-BATCH mode over to the DIRECT mode, proceed as follows:

The instrument is turned on, and you will see APPL BATCH under the units on the display.

- Press the FUNC key and then DIRECT/APPL. The display will show DIRECT and you can start with the measurements.

APPL-BATCH mode (FH 4100 only)

The APPL-BATCH mode is well suited for the comparison of several measurement series and for the management of measurement series in which different probes have been used for measurements. The integrated data logger has more than 99 application memory locations (APPL) available which can be subdivided into 98 batch memory locations (BATCH) each. In this memory range, you can file approx. 500 separate measurement series and statistically evaluate each single measurement series. A maximum total data acquisition capacity is 10,000 single readings. You can print out single readings, statistical values and a histogram.

If you want to switch from the DIRECT mode over to the APPL-BATCH mode, proceed as follows:

The instrument is turned on, and you will see DIRECT under the units on the display.

- Press DIRECT/APPL.
The display shows APPL-BATCH and the pair of numbers of the APPL-BATCH memory location last used, e.g. 2 : 1.
- Continue your measurements in the indicated APPL-BATCH memory location or select a new memory location.

Selecting an APPL-BATCH memory location

To select a memory location, you have to select an application memory (APPL) and a batch memory (BATCH). The calibration values of one or several probes (wall thickness and coating thickness measurement) are stored in the APPL memory locations, the measured values and limit values are stored in the BATCH memory locations. Once a calibration has been carried out, you don't have to repeat it – all you have to do is to recall the corresponding APPL memory location number. After that, you

can select a BATCH memory location and start to measure.

The instrument is turned on and you are working in the APPL-BATCH mode.

- Press DIRECT/APPL.
The pair of numbers of the APPL-BATCH memory location last used is displayed.
- Use the arrow keys to select the required application memory location and press DIRECT/APPL again.
- Press BATCH.
The corresponding pair of numbers is displayed.
- Use the arrow keys to select the required batch memory location and press BATCH again.

The new memory location is now selected and you can start to measure.

■ Note:

If you keep an arrow key pressed, the individual application memory locations or batch memory locations are scrolled through at high speed. The display stops at the first free memory location and the corresponding memory location number flashes.

5.4 Measuring the wall thickness

Make sure that the probe is connected to the instrument and the MiniTest FH 2100 / FH 4100 is turned on. The calibration for the selected probe and the material to be measured has already been carried out (ref. chapter 5.2 *Calibrating the instrument*).

Check that the material surfaces are free from dirt, residual paint, etc., on either side.

Use the supplied magnetic screwdriver when handling the steel ball. This can be re-magnetized from time to time by drawing it over the magnetic tip of the probe.

A Attention:

Choose a measurement location where no other strong magnetic fields can affect the test point. For instance, power transformers or conductor bars with high current intensities can corrupt the resulting measurement data.

- Place the target steel ball in the hollow body to be measured or on the surface of the test object.
- “Recover” the steel ball using the magnetic probe by holding the probe against the opposite side of the material.
The wall thickness is displayed.
- Transfer the reading to the statistics by pressing \hat{u} .
Depending on the basic setting, the readings are also automatically transferred to the statistics (refer to chapter 5.1).

H Note:

If you need both hands for guiding the test object, the use of a probe support and foot switch might provide a solution. The foot switch has the same function as the \hat{u} key.

The two tools are available as accessories through your nearest Elektro-Physik representative.

Display/printout	Single-value statistics	Block statistics
N	Number of single values	Number of blocks or groups
MEAN	Mean value of single values	Mean value of mean values
STD.DEV	Standard deviation	Standard deviation (mean value)
Kvar	Variation coefficient	Variation coefficient (mean value)
MAX	Maximum single value	Maximum single mean value
MIN	Minimum single value	Minimum single mean value
Cp	Process capability index (variation)	
Cpk	Process capability index (variation and mean value)	

5.5 Evaluating the resulting measurement data

The MiniTest FH 2100 / FH 4100 gauges provide two different modes each for the statistical evaluation of your measurement series.

The FH 2100 calculates from a measurement series comprising a maximum of 10,000 stored single values both single-value and block statistics. You can print out either all measured single values, including statistics (PRINT ALL), or only the statistical values (PRINT). The FH 4100 calculates the corresponding statistical values from a maximum of 500 stored measurement series within the APPL-BATCH structure. The printout is made as with FH 2100.

You can define the mode single-value or block statistics in the basic settings (ref. chapter 5.1 *Basic settings*).

Single-value statistics

The readings from a measurement series are always automatically recorded and statistically evaluated. The evaluation provides the statistical values listed in the above table for each measurement series both on the display and in the printout. With the FH 4100, only the single-value statistics can be calculated in the DIRECT mode.

The instrument is turned on.

- Press STATS/CONTINUE to have the number of measurements (N) displayed. Every time the STATS/CONTINUE key is pressed again, another statistical value is displayed, and the display appears in the order of the table.

If you have connected the printer MINIPRINT 4100, you can print out the statistical values.

- Press the STATS/CONTINUE key in order to have the number of measurements (N) displayed and printed out at the same time. Every time the STATS/CONTINUE key is pressed again, another statistical value is displayed and printed out at the same time.

You can generate a list of all statistical values and, if requested, the histogram.

- Press PRINT/PRINT ALL. The complete single-value statistics are printed out.

Moreover, you can generate a complete printout of all measured values and statistics.

- Press the FUNC key and then PRINT/PRINT ALL. All measured values of a measurement series, and, if requested, the histogram, the single-value statistics within the application memory are printed out.

Block statistics

The block statistics evaluation is available for FH 2100 and FH 4100.

The readings of a measurement series are combined to blocks of 5 readings each. Only the average of each block is used for the calculation of the block statistics. The evaluation provides the statistical values listed in the table both on the display and in the printout.

The FH 4100 must be in the APPL BATCH mode for block value statistics, it then reacts the same as the FH 2100. Proceed as follows:

- Press STATS/CONTINUE to have the number of measurements (N) displayed. Every time the STATS/CONTINUE key is pressed again, another statistical value is displayed; and the display appears in the order of the table.
- Press PRINT/PRINT ALL in order to have all statistical values displayed one after another.

If you have connected the printer MINIPRINT 4100, you can print out the statistical values.

- Press STATS/CONTINUE in order to have the number of measurements (N) displayed and printed out at the same time. Every time the STATS/CONTINUE key is pressed again, another statistical value is displayed and printed out at the same time.

You can generate a list of all statistical values.

- Press PRINT/PRINT ALL. The statistical values of all measurement series included in this application memory are printed out.

Moreover, you can generate a complete printout of all measured values and statistics.

- Press the FUNC key and then PRINT/PRINT ALL. All readings of the individual measurement series within the current application memory, including the statistical values and, if requested, the histogram, are printed out.

H Notes:

If you have entered an upper and a lower limit value, the readings are marked accordingly.

< : reading is smaller than the lower limit value

> : reading is higher than the upper limit value

In addition, a histogram is printed out on the print commands PRINT/PRINT ALL and FUNC + PRINT/PRINT ALL if you have predefined an upper and a lower limit value (ref. chapter 5.2 *LIMIT setting*).

Measuring errors are included in the statistical evaluation. You should therefore immediately delete a faulty measurement after the measuring process because the measurement series cannot be corrected at a later date (ref. chapter 5.6 *Delete functions*).

Printout of memory allocation (FH 4100 only)

To check the memory locations, you can print out a list. You will then receive the following detailed information:

- Allocated application memory (APPL)
- Probe type calibrated for the application
- Allocated batch memory (BATCH)
- Number of readings in the batch memory locations

The instrument is turned off, the printer MINIPRINT 4100 is connected.

- Keep the APPL/DIRECT key pressed and additionally press ON/OFF until an acoustic signal is heard.
The list indicating the memory allocation is printed out.

You will find examples of printouts in chapter 6 *Documenting measurement results*.

5.6 Delete functions

The MiniTest FH 2100 / FH 4100 gauges provide a number of different delete functions for measured and calculated values enabling you to selectively delete for example the last value, individual measurement series or limit values. Any calibrations or other measurement series within an application memory are maintained in this process.

Deleting the last reading

The last reading is displayed.

- Press CLEAR.
An acoustic signal will confirm that the value is deleted.

Deleting statistical values on the FH 2100 and in the DIRECT mode on the FH 4100

- Press the FUNC key and then CLEAR/CLR STATS.
An acoustic signal will confirm that all single and statistical values are deleted.

H **Note:**

The following delete functions only apply to the FH 4100.

Deleting a measurement series including statistical values (FH 4100 only)

You can delete a measurement series together with the statistical values within a batch memory (BATCH). The calibration values in the overriding application memory (APPL) are maintained in this process.

Start by selecting the application memory and the batch memory where the measurement series to be deleted is stored.

- To do this, press APPL/DIRECT and select the required application memory using the arrow keys. Finally, press APPL/DIRECT once more.
- After that, press the BATCH key and select the required batch memory using the arrow keys. Finally, press BATCH once more.
- Then press the keys FUNC and CLEAR/CLR STATS one after the other.

Deleting a measurement series including statistical and limit values (FH 4100 only)

You can delete a measurement series together with the statistical and limit values within a batch memory (BATCH). The calibration values in the overriding application memory (APPL) are maintained in this process.

Start by selecting the application memory and the batch memory where the measurement series to be deleted is stored.

- To do this, press APPL/DIRECT and select the required application memory using the arrow keys. Finally, press APPL/DIRECT once more.
- After that, press the BATCH key and select the required batch memory using the arrow keys.
- Then press CLEAR/CLR STATS.
An acoustic signal will confirm that the measurement series, statistical and limit values are deleted; the number of the batch memory location flashes, LIMIT is blanked out on the display.

Deleting limit values (FH 4100 only)

You can delete limit values predefined for a measurement series within a batch memory (BATCH). Any calibration and measured values are maintained.

Start by selecting the application memory and the batch memory where the limit values to be deleted are stored.

- To do this, press APPL/DIRECT and select the required application memory using the arrow keys. Finally, press APPL/DIRECT once more.
- After that, press the BATCH key and select the required batch memory using the arrow keys. Finally, press BATCH once more.
- Then press the keys LIMIT/OFFSET and CLEAR/CLR STATS one after the other.
An acoustic signal will confirm that the limit values are deleted; LIMIT is blanked out on the display.

Deleting all measurement series in an application memory (FH 4100 only)

You can delete all measurement series, including their corresponding statistical, limit and calibration values, within an application memory (APPL).

Start by selecting the application memory where all measurement series are to be deleted.

- To do this, press APPL/DIRECT and select the required application memory using the arrow keys.
- Then press CLEAR/CLR STATS.
Three short acoustic signals are given. You can abort the delete process at this point by pressing APPL/DIRECT.
- To finally delete all measurement series, press CLEAR/CLR STATS again.
A long acoustic signal will confirm that the measurement series are deleted; the number of the application memory flashes on the display.

Deleting all measurement series in all application memory locations (FH 4100 only)

You can delete all measurement series, including the corresponding statistical, limit and calibration values, in all application memory locations.

- Turn the instrument off.
- Press the three keys CLEAR/CLR STATS, FUNC and ON/OFF one after the other and keep them pressed.
A long acoustic signal is heard and confirms that everything has been completely deleted.

5.7 Coating thickness measurement

You can also use the FH 2100 and FH 4100 gauges in combination with special probes for the coating thickness measurement, e.g. in electroplating and paint shops, in automotive and shipbuilding industry, in aircraft construction as well as in apparatus and machine construction.

Depending on the type of the coating thickness probe used (please see table on page 5-31), you can apply the magneto-inductive (F-type probes) or the eddy current method (N-type probes).

F-type probes, e.g. the F3 probe, are meant for nonmagnetic coatings on steel, e.g. chrome, zinc, varnishes/lacquers, enamels.

N-type probes, e.g. the N1.6 probe, are meant for insulating coatings, e.g. lacquers/varnishes, anodizing coatings, ceramic on nonferrous metals such as aluminum, zinc diecasting, brass, etc.

The FN1.6 probe is a universal probe and can be used with both methods.

The probes can be operated both in the DIRECT mode and in the APPL-BATCH mode.

Calibration

The MiniTest FH 2100 / FH 4100 gauges are always calibrated together with the corresponding probe connected in each case. The calibration mainly serves for adapting the gauge to the geometry and the type of material of the test object. Different materials, and especially different radii of curvature ($r < 100$ mm), or small test objects (< 50 mm \times 50 mm) call for a calibration on an uncoated test object having the same material and the same radius of curvature.

Unlike the MiniTest FH 2100 / FH 4100, which operates in the continuous mode as standard mode after being turned on in combination with the thickness probe FH 8, the gauge always switches over to the single measurement mode as standard mode when combined with a coating thickness probe. In this mode, the measured value is displayed as being saved after positioning of the probe and does not change until the next measurement is carried out.

The switchover from the continuous mode to the single measurement mode and vice versa with both probe types can be carried out as follows:

- Press the FUNC key and then CONTINUE/STATS. The other measurement mode is activated in each case.

Four calibration modes are described in the following:

1. Standard calibration
2. Zero calibration or single-point calibration
3. Two-point calibration
4. Calibration on coated surfaces

Depending on the required degree of accuracy, one of the four calibration modes is applied.

Standard calibration

This calibration activates the standard calibration memorized in the instrument. It is carried out without using any calibration block. The subsequent measurements may only be made on a flat surface.

- Hold the probe in the air.
- Press ZERO.

- Press CLEAR.
- Start with the measurement.

Zero calibration

Only an uncoated test object having the same shape and geometry and the same basis material type as the coated test object is required for this calibration.

- Press ZERO.
The display shows a flashing ZERO.
- Place the probe at right angles on the uncoated test object (coating thickness = 0) and lift it off again after the acoustic signal.
Repeat this process several times in order to increase the calibration accuracy.
- Press ZERO once again in order to end the zero calibration.
- Start with the measurement.

Two-point calibration

Required for this calibration is the zero calibration described in the last section and another calibration by means of a calibration standard included in the supply.

- Carry out the zero calibration first.
- Press CTC/CAL.
CAL flashes on the display.
- Lay the calibration standard on the uncoated test object, place the probe with the probe tip on the calibration standard.
- Lift off the probe again after the acoustic signal and place it on the calibration standard again several times in order to increase the calibration accuracy. The display indicates the mean value of the readings.
- Vary the displayed reading using the arrow keys until you have set the value marked on the calibration standard.
- Press CTC/CAL again to end the two-point calibration.

- Start with the measurement.

H **Note:**

The calibration using thickness calibration standards (CAL) can be repeated as often as required. However, the zero calibration (ZERO) is maintained.

A new zero calibration (ZERO) will nevertheless clear the calibration using the thickness calibration standards. This must be carried out again if required.

Calibration on coated surfaces

(Method according to licensed patent DE3404720C2)

This method is appropriate if there is no uncoated test object available. The method can be applied using the probes F06, F1.6, FN1.6 (F part), F1.6/90, F10 and F20. The method may only be applied if the coating on the calibration point is even and smooth enabling reproducible measured values; e.g. do not use it on structural coats of varnish or lacquer.

- Press the FUNC key and then CTC/CAL.
The CTC calibration is initialized. The LC display shows a flashing “CTC” and a non-flashing “MEAN”. The display “MEAN” indicates that the mean value of the measurements is shown.
- Place the probe on the test object at the calibration point and lift it off again after the acoustic signal.
- Place the probe on the test object several times.
The mean value of the last readings is displayed.
- Press CTC/CAL.

- Lay the calibration standard on the same calibration point, pinpoint the probe on the calibration standard as accurately as possible at the previous calibration point and lift it off again after the acoustic signal.

H **Note:**

The thickness of the calibration standard should correspond more or less to the coating thickness to be expected.

Type	Measuring range	Field of application
F06	0 ... 0.6 mm	Iron and steel
F1.6	0 ... 1.6 mm	
F3	0 ... 3 mm	
F1.6/90	0 ... 1.6 mm	
F10	0 ... 10 mm	
F20	0 ... 20 mm	
F50	0 ... 50 mm	
FN1.6	0 ... 1.6 mm	Iron and nonferrous metals
FN1.6/90	0 ... 1.6 mm	
N1.6	0 ... 1.6 mm	Nonferrous metals
N1.6/90	0 ... 1.6 mm	
N10	0 ... 10 mm	
N20	0 ... 20 mm	
N100	0 ... 100 mm	
CN02	10 ... 0.2 mm	

- Place the probe on the test object several times.
The mean value of the last readings is always displayed. The calibration can be interrupted by pressing CLR STATS/CLEAR.
- Set the coating thickness using the arrow keys.
- Press CTC/CAL.
The display shows “CTC” which is not flashing.
- Place the probe on the unknown coating thickness and lift it off again after the acoustic signal.
- Read the measured value.

If you have entered an incorrect calibration value, clear the calibration as follows:

- Press the keys FUNC, CAL and CLEAR one after the other.
The CTC calibration is cleared.

H Note:

The factory standard calibration for flat surfaces is now activated.

You can calibrate and operate the coating thickness probes F06, F1.6, F3, F10 and N1.6 as described above without having to take any special preparatory measures.

The probes F20, F50, F1.6/90, CN02, FN1.6, N10, N20 and N100 described below require different preparatory measures for coating thickness measurement according to the following description.

Probe F20

If you turn on the MiniTest FH 2100 / FH 4100 with a probe connected to it, the instrument is automatically switched over to the "continuous mode". In the case of this probe, you should compensate for the temperature and drift effects by holding the probe in the air and then pressing the keys FUNC and ZERO. You can calibrate the probe after the acoustic signal.

Probe F50

In this case, the position of the probe with regard to the surface to be measured affects the measurement results. You have to keep the same angle to the test object during the calibration as it will be during the

subsequent measurement. Moreover, you should always move the probe onto the test object at a constant speed.

To avoid any hysteresis errors, you have to remove the probe at least 30 cm away from any metal after every measurement.

⚠ Attention:

The magnetic field generated by the probe can influence or even destroy electronic devices or gauges! Stay at a clearance distance of 15 cm away, especially from any computers, display screens or magnetic data recording media.

Tube probes F1.6/90 und N1.6/90

You can carry out the normal calibration and measurement processes as described previously in the operating mode "single-value measurement". In the operating mode "continuous measurement", the operation differs as follows:

- Carry out the calibration in the mode “single-value measurement”.
- Transfer the value last displayed to the statistics memory by pressing $\hat{\uparrow}$ during the continuous measurement.

Probe CN02

If you want to carry out copper thickness measurements on double-faced p.c. boards, you have to carry out the calibration likewise on a two-sided copper standard.

When measuring other nonferrous metal coatings, the calibration described above has to be carried out using a calibration standard made of the same metal (if required, consult the corresponding manufacturer).

Universal probe FN1.6

The universal probe FN1.6 operates both according to the magneto-inductive method (F part) and according to the eddy current method (N part). The measuring range of the universal probe FN1.6 is 0 ... 1600 μm for both methods.

Select the measurement method while the instrument is turned on. The display shows a flashing FERROUS.

- Press $\hat{\uparrow}$ to select the magneto-inductive method FERROUS .
- Press $\hat{\downarrow}$ to select the eddy current method NON-FERROUS .

If you make no choice, the magnetic method FERROUS is set after approx. 5 seconds.

The calibration and measurement processes are the normal ones described.

Probes N10 and N20

For calibrating the probes N10 and N20 you have to take the dielectric material properties of the calibration standard and of the coating thickness material into account.

- Place the probe on the thicker calibration standard of the two attached ones, however, without any metal base support.
To avoid additional dielectric effects, use an expanded polystyrene block having a thickness of approx. 3 cm or more as base support for the calibration standard.
- Press the keys FUNC and ZERO one after the other.
- Eliminate the parasitic dielectric inductions of the coating material by placing the probe on the coating material, however, without any metal base, and by pressing the keys FUNC and ZERO one after the other.

H Note:

The automatic compensation of the temperature effects is no longer active. Please repeat the calibration with temperature variations if required.

Probe N100

The metallic base for the wall and coating thickness measurement using the probe N100 can consist both of iron and of a nonferrous metal. The metal area should be 30×30 cm or larger. With a smaller metal area, which must nevertheless not be smaller than 15×15 cm, the measuring error may become larger.

The same calibration rules as for the probes N10 and N20 apply to this case as well.

Documenting measurement results **6**

6.1 Printer

The portable printer MiniPrint 4100 is supplied with power from four NiMH batteries. You can operate the printer via the power supply unit included in the supply and also charge the batteries. A fully charged battery lasts for several thousand printed lines. The charging time is approx. 14 hours. The charge of the battery is indicated by two LED's. The red LED (LOW) signals that the batteries are discharged. The yellow LED (CHARGE) signals with connected power supply unit that the batteries are being charged. As soon as the yellow LED is extinguished, the batteries are fully charged. The internal charging circuit of the MiniPrint 4100 is switched to trickle charging. Therefore, the batteries cannot be overcharged.

A Attention:

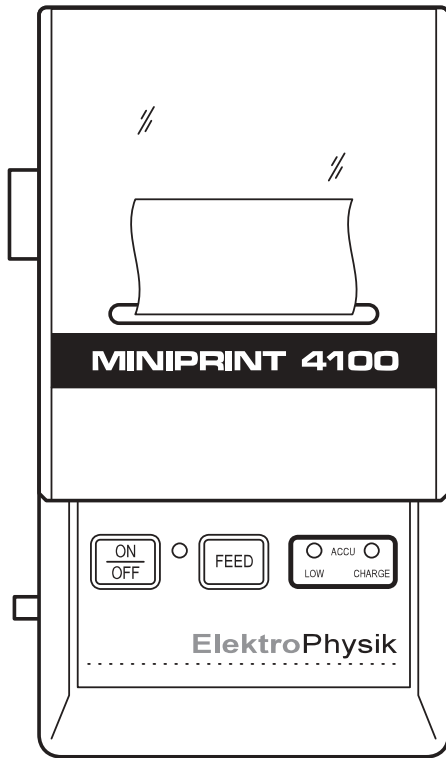
Printer explosion hazard!

Before connecting the power supply unit to the printer MiniPrint 4100, you must ensure that the instrument contains rechargeable NiMH batteries!

If non-rechargeable alkaline batteries are inserted into the instrument, they can explode and cause severe injuries to the operator!

The printer MiniPrint 4100 enables to print out

- all single readings,
- the statistical values,
- the histograms (only with FH 4100) and
- the memory allocation



Key	Description
-----	-------------

ON/OFF	To turn the instrument on or off
--------	----------------------------------

FEED	Line feed
------	-----------

LED	Description
-----	-------------

green	Printer is turned on
-------	----------------------

red (LOW)	Batteries are discharged
-----------	--------------------------

yellow (CHARGE)	Batteries are being charged
-----------------	-----------------------------

6.2 Printer start-up

On delivery, the printer MiniPrint 4100 is equipped with 4 discharged NiMH batteries and a roll of paper. You have to charge the batteries by means of the power supply unit included in the supply before using the printer for the first time. The charging time is approx. 14 hours.

H **Note:**

The printer MiniPrint 4100 can only be activated if it is connected with the thickness gauge MiniTest FH 2100 / FH 4100 and the thickness gauge is turned on.

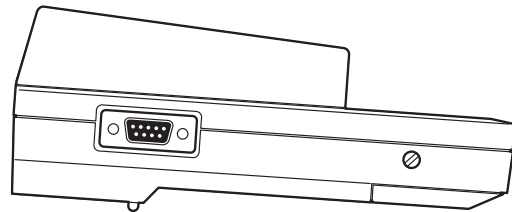
Charging batteries

- Connect the printer MiniPrint 4100 with a socket outlet (220 V) via the power supply unit. The yellow LED (CHARGE) is lit.
- Disconnect the power supply unit from the mains supply when the yellow LED is extinguished. The batteries are now charged.

Connecting the printer

- Connect the lateral 9-pin female connector of the printer MiniPrint 4100 with the 9-pin interface of the MiniTest FH 2100 / FH 4100 by intermating the two instruments alongside one another. Make sure the guide pin on the printer housing fits in the corresponding hole on the thickness gauge. Remove the blanking plug on the MiniTest beforehand.
- Turn on the thickness gauge using the ON/OFF key.
- After that, turn on the printer using the ON/OFF key.
- Check that the papertape sticks out of the plexiglass cover – if required, press FEED several times.

You can now print out measured values and statistics from the MiniTest FH 2100 / FH 4100.



Changing the roll of paper

The thickness gauge and the printer are turned on.

- Push the plexiglass cover aside toward the back and remove the remaining used roll of paper.
- Take the papertape of the new roll so that it is unrolled downwards from the roll.
- Check that the papertape has a straight edge of cut – if required, cut a piece off using scissors.
- Put the end of the papertape below the ink ribbon cartridge into the metallic paper guide.
- Press FEED until the papertape juts out approx. 2 cm in front of the ink ribbon cartridge.
- Roll up the paper and put the roll of paper into the hollow behind the ink ribbon cartridge.
- Put the plexiglass cover over the roll of paper and lead the end of the papertape through the slot in the cover. To do this, bend the papertape forward below the cover. The papertape will then easily slide through the slot.

Changing the ink ribbon cartridge

The ink ribbon is provided in the form of a closed loop in a plastic cartridge and can be easily exchanged.

- Push the plexiglass cover aside toward the back and remove the roll of paper.
- Pull the paper still wound up cautiously out toward the back.
- Press from above on the right side of the ink ribbon cartridge (marked “Push”) with your index finger. The left side of the cartridge is then lifted up so that you can easily remove it by pulling it upward.
- Check that the ink ribbon of the new cartridge is stretched tight. If necessary, turn the corrugated tightening element in the direction of arrow.
- Lead the new ink ribbon cartridge straight from above into the printing unit and make sure the ink ribbon is not twisted.
- Install the roll of paper according to the instructions in the previous section.

Carrying out printer self-test

The printer MiniPrint 4100 has a self-test function so that you can check the correct functioning of the printer and of the ink ribbon.

The printer is connected with the thickness gauge MiniTest FH 2100 / FH 4100.

- Turn on the MiniTest FH 2100 / FH 4100.
- If necessary, turn off the printer by pressing ON/OFF, and the green LED is extinguished.
- Keep the FEED key pressed and, in addition, press ON/OFF until the printout starts.
The printer starts with the self-test and prints out line by line, always offset by one character, the fonts available.
- After approx. 20 lines, you can break off the self-test by pressing ON/OFF

Printout of APPL-BATCH directory (FH 4100 only)

The instrument is turned off.

- Turn on the printer.
- Press DIRECT/APPL, then press ON/OFF and keep both keys pressed until you hear an acoustic signal. The APPL-BATCH directory is printed out via the printer (please see opposite example).

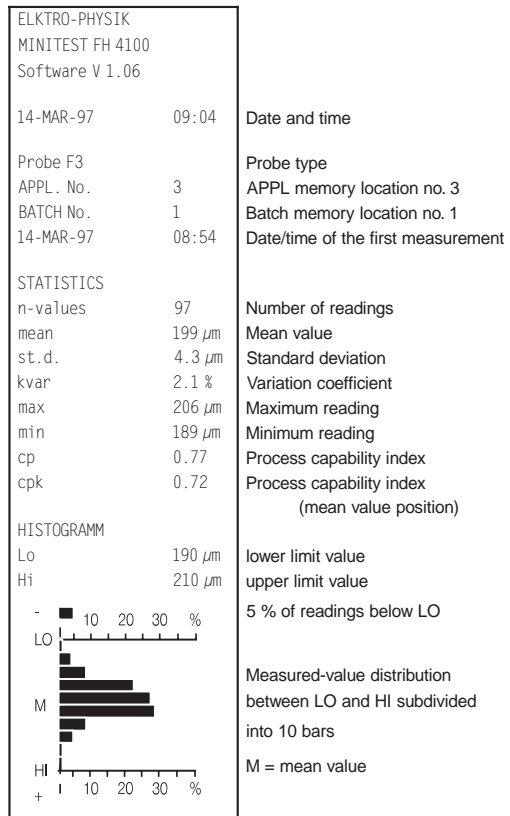
ELEKTRO-PHYSIK		
MINITEST FH 4100		
Software V 1.06		
Probes		Existing probes
A0		
A1		
...		
B4		
APPL-BATCH		APPL-BATCH
Directory		Directory
APPL. No. 1		APPL memory location
Probe N2		no. 1 activated
Code A2		Probe type
		Probe code
BATCH No. 2		BATCH 2 contains
Number 6		6 measured values
BATCH No. 5		BATCH 5 contains
Number 5		5 measured values
APPL. No. 4		APPL memory location
Probe F06		no. 4 activated
Code A0		Probe type
		Probe code
BATCH No. 1		BATCH 1 contains
Number 5		5 measured values
BATCH No. 98		BATCH 98 contains
Number 17		17 measured values
End		End of directory

The adjacent figure is not an original printout but is an example with a description of possible points which such a printout could contain.

Printout of single-value statistics with histogram (FH 4100 only)

If the operating mode single-value statistics has been activated, these statistical values and all single readings of a measurement series can be printed out as follows.

- Turn on the printer.
- Press the keys FUNC and PRINT ALL/PRINT.
 With the printer connected, a printout of
 - all readings of a measurement series,
 - the single-value statistics and
 - the histogram with FH 4100 is made (if you have preset the LIMIT values LO and HI).



Application software MSOFT41

The application software MSOFT41 is a data transfer program for the gauges MiniTest FH 2100 / FH 4100. The program enables to transfer the data saved in the gauge to a PC and to store them in a database. The data are stored specifically for each project, i.e. the data can be arranged according to applications and stored in different project databases.

During the data transfer, you can decide whether the data in the gauge should be deleted or not after the transfer; however, the structure of the applications and batches will then be maintained. The data stored in the project database can be further processed with the program.

You can view the distribution of wall or coating thickness in a histogram and a trend diagram, have the statistics calculated, combine readings in groups and have the group statistics calculated. In addition, you can print out the readings, statistics, histogram and trend diagram in a documentation header of your own.

The program offers you great versatility with the data management. You can merge data from different projects by means of the import function, clear an application or a batch within a project or the complete project. Moreover, you have the possibility of exporting measurement data to other applications, e.g. a spreadsheet such as Excel for Windows, via the Windows clipboard, and to further process them there.

You need the following PC equipment:

- PC, 100% IBM-compatible,
- 386 CPU or higher,
- 4MB RAM or more,
- at least 10 MB free hard-disk memory space,
- MS-DOS 6.x or later version with Windows 3.1 or higher.

Maintenance and care **7**

7.1 Care

Instrument care

Clean the instrument and the accessories using a moist cloth. Use water or a mild household detergent.

A Attention:

Do not use any solvents!
The plastic parts can be damaged or become brittle by them.

How to use NiMH batteries

Please observe the following information in order to increase the operating times and life of NiMH batteries:

- Always discharge the batteries completely before recharging them.
To achieve this, leave e.g. the printer on until it is automatically turned off. The MiniTest must be turned on for this purpose.
- Always charge the batteries fully.
If you end a charging process too early, the battery cannot be charged up to its full capacity any more.
- Operate the batteries in a power-saving mode.
Use the short-time duty on the MiniTest FH 2100 / FH 4100 and turn off the printer MiniPrint 4100 if you don't want to make any printout.

7.2 Maintenance

In general, the thickness gauge MiniTest FH 2100 / FH 4100 and the printer MiniPrint 4100 require no maintenance work.

A Attention:

Any repair work may only be executed by authorized Krautkrämer Service personnel.

Technical data 8

Technical data

Function principle	Magnetic method for nonmagnetic materials	
Probe	FH8 (for thickness measurements)	
Display Resolution	<u>Range</u>	<u>Resolution</u>
	0,0 - 9,9 μm	0,1 μm
	10,0 - 19,8 μm	0,2 μm
	20,0 - 99,5 μm	0,5 μm
	100 - 999 μm	1,0 μm
	1,000 - 1,495 mm	5,0 μm
	1,50 - 4,99 mm	10,0 μm
	5,00 - 14,95 mm	50,0 μm
Measuring range	Dependent on the diameter of the target steel ball:	
	<u>Steel ball</u>	<u>Measuring range</u>
	Ø 1.5 mm	0 ... 2 mm (0 to 80 mils)
	Ø 3 mm	0 ... 4 mm (0 to 160 mils)
	Ø 5 mm	0 ... 8 mm (0 to 320 mils)
Calibration	Zero calibration and two-point calibration using calibration standards	
Units	mm or inch	

Statistics functions Single-value and block statistics, with mean value, standard deviation, variation coefficient; process capability index for FH 4100 only

Data Logger	FH 2100	FH 4100
Application memories	1	99
Batch memories	1	98
Storable measurement series	1	500
Storable readings	10,000	10,000

Measuring accuracy

Measuring range	Measuring accuracy	
	Only zero calibration	Two-point calibration
0 ... 2 mm	$\pm(5 \mu\text{m} + 3 \%^*)$	$\pm(5 \mu\text{m} + 1 \%^*)$
0 ... 4 mm	$\pm(10 \mu\text{m} + 3 \%^*)$	$\pm(10 \mu\text{m} + 1 \%^*)$
0 ... 8 mm	$\pm(20 \mu\text{m} + 3 \%^*)$	$\pm(20 \mu\text{m} + 1 \%^*)$

*) measurement value

Technical data

Display	4-digit LCD with analog bar graph display
Display/measurement rate	7 measurements/second
Minimum radius of curvature	convex: dia. > than the diameter of target steel ball concave: dia. > 25 mm (1.0 inch)
Power supply	1 monoblock battery (alkaline AIMn, 9 V, type 6 AM 6) or via power supply unit
Operating time	> 10,000 measurements with 1 battery
Ambient temperature	Instrument: 0 ... 50 °C (32... 122 °F), probes 10 ... 40 °C (50... 104 °F)
Dimensions	150 mm × 82 mm × 35 mm (6 inches x 3.2 inches x 1.4 inches)
Weight	270 g (0.6 lb.) including batteries

Probes for coating thickness measurement

Please refer to chapter 5.7 *Coating thickness measurement* and to the table on page 5-31.

Interface 9

9.1 Description of interfaces

The MiniTest FH 2100 / FH 4100 gauges can be connected to a computer via the bidirectional RS232C interface.

Data format

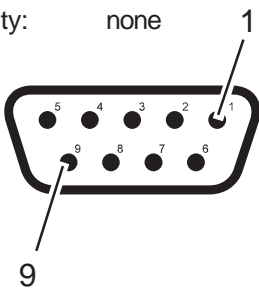
The physical data transfer via the RS232C interface is made in the following data format:

Baud rate: 9600

Data bits: 8

Stop bit: 1

Parity: none



Pin no.	Signal
1	–
2	RxD →
3	TxD ←
4	–
5	GND
6	–
7	–
8	–
9	–

Interface allocation

The connection to a PC is made via the 9-pin D-SUB socket shown here. You can see the pin assignment below.

Remote control

The MiniTest FH 2100 / FH 4100 can be remotely controlled from a PC.

The data transfer is carried out by means of remote-control codes. For more details, please contact ElektroPhysik Service-Center.

Annex 10

10.1 Definitions for statistics

The statistical evaluation is meant to help you to assess your measurements better and to make your decisions on the quality of the tested material more reliable.

Mean value \bar{x} (Mean)

The mean value \bar{x} is the total of single values, divided by the number of readings.

$$\bar{x} = \frac{\sum x}{n}$$

Standard deviation s (St. D)

The standard deviation is a measure for the variation of readings.

The standard deviation s results from the positive square root of the variation s^2 .

$$s^2 = \frac{\sum (x - \bar{x})^2}{n-1}$$

The variation is the total of the squared deviations of the readings from their arithmetic mean value divided by the number of readings reduced by 1.

Variation coefficient (Kvar)

The variation coefficient is the standard deviation divided by the arithmetic mean value, the data being indicated as a percentage.

$$K \text{ var} = \frac{s}{\bar{x}} \times 100\%$$

Process capability index (Cp) (only FH 4100)

The Cp index is a measure for the variation of readings in relation to the specification limits, it only takes the variation into account and is calculated from

$$Cp = \frac{OSG - USG}{6s}$$

USG = lower specification limit (LSL)

OSG = upper specification limit (USL)

Process capability index (Cpk) (only FH 4100)

The Cpk index takes the position of the mean value with regard to the specification limits into account in addition to the variation.

$$C_{pku} = \frac{\bar{x} - USG}{3s}$$

$$C_{pko} = \frac{OSG - \bar{x}}{3s}$$

$$C_{pk} = \text{Min}\{C_{pku}, C_{pko}\}$$

10.2 Error messages

The list of errors below informs you about the detection and elimination of errors or faults. All error messages start with the letter "E" (E = Error = Fault).

Errors causing an instrument turn-off:

- E 01 Probe not accepted.
- E 02 No probe connected. Only displayed if no probe is connected immediately after a reset.
- E 03 Probe is defective. This error message is displayed either when the instrument is turned on or when the probe is unplugged during the operation.
- E 04 Probe produces instable readings (e.g. due to the effect of strong external magnetic alternating fields or when measuring on ductile coatings).
- E 05 The probe has not been hold far enough (>100mm) from steel. Hold the probe far from steel and switch on again.

If E5 appears when switching on although there is no steel nearby, the gauge can be used

conditionally. However, the gauge must be checked with standards and the relative steel ball.

If the deviation is too high, a two-point calibration is necessary. Use a calibration standard with a thickness near to the expected thickness of the sample to be measured. On occasion, the probe should be returned for repair.

E 06 Battery voltage is too low.

Errors only displayed for approx. 1.5 seconds:

E 11 Measured-value memory is full.

E 12 Zero calibration is not accepted.

E 13 CTC calibration is not accepted.

E 14 Cal2 calibration is not accepted.

E 15 1-point calibration is not possible after the CTC calibration.

E 16 Another probe has already been assigned to the selected application, or the probe was repaired.

No "E" is displayed with the following general errors:

- Gauge is not automatically turned off
- Gauge does not allow any further measurements
- Keys do not have any allocated function
- Displayed values are illogical

Reset the MiniTest FH 2100 / FH 4100 in these cases.

- To do this, turn the instrument off.
- Keep the two keys FUNC and CLEAR/CLR STATS pressed and, in addition, press ON/OFF. A long acoustic signal confirms the clearing process. All readings, calibration values and preset limit values are cleared.

H **Notes:**

The time and date data are maintained at a reset.

If the instrument cannot be turned off using the keypad, remove the battery for a short time before the reset.

10.3 EC declaration of conformity

We declare that the MiniTest FH 2100 / FH 4100 and the printer MiniPrint 4100 conform to the safety requirements of the EMC directive 89/336/EEC, implemented in Germany by the law on electromagnetic compatibility of equipment (German abbreviation: EMVG) enacted on 9.11.1992.

10.4 Service addresses

The MiniTest FH 2100 / FH 4100 gauges are manufactured according to state-of-the-art methods using high-quality components. Thorough in-process inspections and a quality management system certified to DIN EN ISO 9001 ensure an optimum workmanship of the gauge.

Should you nevertheless detect an error or malfunction on your gauge, please inform the ElektroPhysik Service responsible for your products, giving the details and a description of the error or malfunction.

Keep the shipping container for any repair work possibly required that cannot be executed on site.

If there's anything specific you would like to know about the use, handling, operation and specifications of the gauges, please contact your nearest ElektroPhysik representative, or the following addresses direct:

Deutschland

ElektroPhysik
Dr. Steingroever GmbH & Co. KG
Pasteurstr. 15
D- 50735 Köln

Tel.: 00 49 - 2 21 - 7 52 04 - 0
Fax: 00 49 - 2 21 - 7 52 04 - 67

www.elektrophysik.com
info@elektrophysik.com

USA

ElektroPhysik USA Inc.
770 West Algonquin Road
Arlington Heights, IL 60005

Tel.: 00 1 - 8 47 - 4 37 - 66 16
inside USA: 1 - 8 00 - 7 82 - 15 06
Fax: 00 1 - 8 47 - 4 37 - 00 53

Changes 11

Changes

This chapter contains the latest changes or additions if any.

Otherwise this chapter remains empty.

Index **12**

Index

A		
Accessories		
Recommended	2-5	
Required	2-4	
Alarm horn	5-9	
APPL-BATCH		
- Mode	5-17	
Print out of -Directory	6-7	
Selecting a memory location	5-18	
Application memory location	5-17	
Application software MSOFT41	6-9	
B		
Basic settings	5-2, 5-3	
Batch memory	5-17	
Batteries		
Care of	7-2	
Charging printer	6-4	
Inserting	3-2	
Block statistics	5-20, 5-22	
C		
Calibrating	5-10	
Calibration methods	5-12	
Coating thickness measurement	5-27	
Suitable types of probes	5-31	
Connecting the power supply	3-3	
D		
Data format	5-5	
Data logger	5-17	
Data transfer to the	5-6	
Deleting		
last reading	5-24	
limit values	5-25	
measurement series	5-24, 5-25	
statistical values	5-24	
Description of the gauge	1-6	
DIRECT mode	5-17	
Display backlight	5-8	
Display resolution	4-3	
E		
Error messages	10-3	
Evaluating the resulting measurement data	5-20	
F		
Foot switch	1-8	

I		
Inputs and outputs	1-8	
Instrument		
Calibrating the	5-10	
Care of	7-2	
Turning on and off the	4-6	
Interfaces		
Description of	9-2	
RS232C	9-2	
K		
Key lock	5-7	
L		
LCD test	5-3	
LIMIT setting	5-16	
Limit value		
Deleting a	5-25	
Presetting a	5-16	
M		
Maintenance	7-3	
Mean value	10-2	
Measurement data		
		Evaluating the resulting
		5-20
		Measurement series
		Deleting of
		5-26
		Management of
		5-17
		Measuring accuracy
		8-3
		Measuring range
		8-2
		Measuring the wall thickness
		5-19
		Memory allocation
		Printout of
		5-23
		Minimum reading
		5-8
		MSOFT41
		6-9
		N
		NiMH batteries
		7-2
		O
		Off mode
		5-5
		OFFSET setting
		5-15
		Operating mode
		Selecting the
		5-17
		P
		Power supply
		3-2
		Printer
		Carrying out self-test
		6-6

Index

Changing the ink ribbon cartridge	6-5	Statistics	5-6
Changing the roll of paper	6-5	Deleting of	5-24
Connecting the	6-4	Storage batteries	
Operational controls	6-3	for the FH 2100 / FH 4100 μ	1-3
Using the	6-2	T	
Probe		Thickness measurement	
Connecting the	3-4	Limitations of	1-5
How to use the	4-7	Preconditions	1-4
Process capability index	10-2	Time and date	
R		Setting the	5-2
Radius of curvature	8-3	Turning off	4-6
RS232C	9-2	Turning on	4-6
S		Two-point calibration	5-14
Safety information	1-2	U	
Scope of supply	2-3	Units	5-4
Selecting the operating mode	5-17	Using the power supply unit	3-3
Service addresses	10-6	V	
Single reading	5-17	Variation coefficient	10-2
Single-value statistics	5-20, 5-21	Z	
Single-value statistics with histogram		Zero calibration	5-13
Printout of	6-8		
Stable reading	5-7		
Standard deviation	10-2		